Patent Claims

1. Multiple substrate with ceramic layer (1) which forms at least two panels (1') which are connected integrally with one another (1) and which adjoin one another in a first axial direction (x-axis, Y-axis) lying in the plane of ceramic layer (1), and which are each provided on at least one surface side of ceramic layer (1) with at least one metal coating or metal surface (2), characterized in that at least two panels (1') adjoin one another on at least one predetermined breaking line (3, 4) in ceramic layer (1), the line running in a second axial direction (Y axis, X axis) which encloses an angle with the first axial direction and likewise lying in the plane of ceramic layer (1), that on at least one border area (1'', 1''') of the ceramic layer outside panels (1') on at least one surface side of this ceramic layer there is additional metal surface (5, 6) which bridges predetermined breaking lines (3, 4) between panels (1') or their imaginary extensions, and that in ceramic layer (1) between this additional metal surface (5, 6) and adjacent panels (1') there is another external predetermined breaking line (3, 4).

2. Multiple substrate according to claim 1, wherein the axial directions (x axis, y axis) enclose an angle of 90° with one another.

3. Multiple substrate according to claim 1 or 2, wherein there are panels in at least two adjacent rows (R1-R3) of ceramic layer (1) which follow one another in a first axial direction (x axis), each row having at least two panels (1') which adjoin one another at a time in the second axial direction (y axis), wherein on at least two border areas (1'', 1''') which run perpendicular to one another there is at least one additional metal surface (5, 6) at a time, of which metal surface (5) on one border area (1'') bridges predetermined breaking lines (4) which run in the first axial direction (x axis) between panels (1') or their imaginary extensions and at least one metal surface (6) on the other border area (1''') bridges predetermined breaking lines (3) which run in the second axial direction (y axis) between panels (1') or their imaginary extensions, and wherein first border area (1'') via external predetermined breaking line (3) which runs in the second axial direction (Y axis) and second border area (1''') via external predetermined breaking line (4) which runs in the first axial direction (x axis) adjoin adjacent panels (1').

4. Multiple substrate according to claim 3, wherein at least one external predetermined breaking line (3) or its imaginary extension is not bridged by additional external metal surfaces (5, 6).

5. Multiple substrate according to claim 3 or 4, wherein at least two border areas (1'', 1''') adjoin one another at a right angle.

6. Multiple substrate according to one of claims 3 - 5, wherein that external predetermined breaking line (3) via which

first border area (1'') adjoins adjacent panels (1') or the imaginary extension of this external predetermined breaking line (3) is not bridged by additional metal surfaces (5', 6'), and wherein at least one additional metal layer (5) on first border area (1'') bridges the predetermined breaking lines between second border area (1''') and adjacent panels (1') or their imaginary extension.

7. Multiple substrate according to one of claims 3 - 6, wherein ceramic layer (1) forms four border areas which adjoin one another at right angles and wherein of these border areas two border areas opposite one another are each first border areas (1'') or second border areas (1''').

8. Multiple substrate according to one of claims 1 - 7, wherein ceramic layer (1) is scratched on at least one surface side or is provided with groove-shaped depressions to form predetermined breaking lines (3, 4).

9. Multiple substrate according to one of claims 1 - 8, wherein the metal coatings are metal surfaces (2) which run with their border lines parallel to predetermined breaking lines (3, 4), preferably rectangular or square metal surfaces (2).

10. Multiple substrate according to one of claims 1 - 9, wherein on panels (1') on both surface sides of ceramic layer (1) there is at least one metal coating or metal surface (2) at a time.

11. Multiple substrate according to one of claims 1 - 10, wherein on the respective border area (1'', 1''') there is continuous metal surface (5, 6) which bridges predetermined

breaking lines (3, 4) which extend perpendicularly or transversely to this border area or their imaginary extensions.

12. Multiple substrate according to one of claims 1 - 11, wherein on border area (1'', 1''') on both surface sides of ceramic layer (1) there is one additional metal surface (5, 6) each.

13. Multiple substrate according to one of claims 1 - 12, wherein metal surfaces (2) which form the metal coatings and additional metal surfaces (5, 6) are connected flat with ceramic layer (1) by the direct bonding process.

14. Process for producing a multiple substrate according to one of claims 1 - 13, wherein ceramic layer (1) is provided on at least one surface side with a metal layer and wherein then by means of a prestructuring process the metal coatings or metal surfaces (2) and at least one additional metal surface (5, 6) provided on at least one border area (1'', 1''') are formed from this metal layer.

15. Process according to claim 14, wherein after completion of prestructuring preferably by mechanical treatment, for example, by scratching, or by laser treatment, predetermined breaking lines (3, 4) are produced.

16. Process according to claim 14 or 15, wherein prestructuring takes place by means of an etching technique and/or by mechanical treatment.

17. Process according to one of claims 14 - 16, wherein application of the metal layer to ceramic layer (1) takes place

by flat joining of a metal foil or thin metal plate to the ceramic layer by means of the direct bonding process.

18. Process according to one of claims 14 - 17, wherein before prestructuring the two surface sides of ceramic layer (1) are provided with a metal layer.

Multiple Substrate and Process for its Production

The invention relates to a multiple substrate according to the preamble of claim 1 and to a process for producing one such multiple substrate.

Ceramic-metal substrates and thus especially also ceramic-copper substrates are known. These substrates are used for producing electrical circuits, especially power circuits.

In the simplest case these substrates have a ceramic layer which is provided on both surface sides with one metal coating each, of which, for example, the metal coating on the top of the ceramic layer is structured, for example, using an etching technique such that this metal coating then forms the printed conductors, contact surfaces, etc. required for the circuit.

For efficient fabrication of electrical circuits, production of these circuits in multiple panels is also known, i.e., especially structuring of metal surfaces to achieve the necessary printed conductors, contact surfaces, etc., but also outfitting with electrical components on a multiple panel which is then separated after completion of structuring, but preferably after assembly, into individual circuit substrates or into individual circuits.

If this technique is to be used for efficient fabrication of metal-ceramic substrates for electrical circuits or electrical circuits produced using these substrates, a multiple metal-ceramic substrate is necessary which forms several panels on an individual ceramic layer. On these panels the ceramic layer is provided on at least one surface side with a metal coating, in

which the metal coatings are not joined to one another on adjacent panels of course, but are separated from one another at least on the transition between adjacent panels.

Since the ceramic layer of a multiple substrate of this type has a relatively large area and there is no continuous metal coating or metal layer on any surface side of this ceramic layer, unwanted breaking of the ceramic layer, for example, during structuring of the metal surfaces to accomplish the necessary printed conductors, contact surfaces, etc. or in other treatment processes cannot be precluded with certainty even with careful handling.

The problem of the invention is to devise a multiple substrate which avoids these defects and in which, in spite of a host of panels formed on a common ceramic layer with metal coatings separated from panel to panel in each case, the danger of unwanted breaking of the ceramic layer or the multiple substrate is effectively prevented.

To solve this problem a multiple substrate according to the characterizing part of patent claim 1 is formed.

One preferred process for producing the multiple substrate is the subject matter of the characterizing part of patent claim 14.

In the invention the predetermined breaking lines or their extensions which run between the panels are bridged by at least one additional metal surface so that bending forces which could lead to unwanted breaking of the multiple substrate during treatment are at least partially accommodated by this additional

metal surface and thus breaking of the multiple substrate is effectively prevented. Preferably on both surface sides of the ceramic layer there are these additional metals surfaces on at least one border area.

For a large number of panels they are formed in several rows offset against one another in a first axial direction on the ceramic layer, each row having several adjoining panels. In this case then on at least two border areas which lie outside the panels and which adjoin one another at right angles there is one additional metal surface each. Each border area adjoins adjacent panels via an external predetermined breaking line. The additional metal surface on each border area bridges the predetermined breaking lines which run transversely or perpendicularly to this border area between the panels, or the imaginary extensions of the breaking lines and the metal surface on one of the border areas also bridges that external predetermined breaking line or its extension which is provided between the other border area and bordering panels. The external predetermined breaking line between the one border area and the bordering panels or the imaginary extension of this predetermined breaking line is not bridged in this case by any additional metal surface. By means of this configuration the desired breaking of the multiple substrate into individual substrates or into individual circuits is possible only in a certain sequence such that first one border area on the external predetermined breaking line which runs parallel to this border area is broken off and subsequently the other border area on the external predetermined

breaking line which runs parallel to this border area is broken off. Only then is separation of the individual panels by breaking possible.

The multiple substrate can be easily handled in a treatment process such that breaking cannot occur on the external predetermined breaking line which runs parallel to one border area, with which then unwanted breaking on other predetermined breaking lines is also precluded.

Developments of the invention are the subject matter of the subclaims.

The invention is detailed below using the Figures on one example of an embodiment.

Figure 1 shows in a simplified representation and an overhead view a multiple substrate according to the invention;

Figure 2 shows a section according to line I - I of Figure 1;

The multiple substrate shown in the figures consists essentially of ceramic layer 1 which is, for example, an aluminum nitride ceramic or an aluminum oxide ceramic and in the embodiment shown is provided with a large number of metal coatings in the form of rectangular metal surfaces 2 on both surface sides. These metal surfaces 2 which consist of copper and are each joined flat to the respective surface side of ceramic layer 1 have each the same shape and size in the embodiment shown and are each made rectangular. Directly opposite each metal surface 2 on one surface side of ceramic

layer 1 is metal surface 2 on the other surface side of this ceramic layer.

It goes without saying that the metal surfaces can also have a shape deviating from rectangular and/or metal surfaces 2 on each surface side of ceramic layer 1 or on the two surface sides of this ceramic layer can be differently shaped.

There are metal surfaces 2 on the two surface sides of ceramic layer 1 in several rows and in the embodiment shown in a total of three rows R1-R3, of which each has four metal surfaces. Metal surfaces 2 which follow each other in succession in rows R1-R3 and also the metal surfaces of adjacent rows are each spaced at a distance from one another on both surface sides of ceramic layer 1 such that the center lines lie parallel to rows R1-R3 and perpendicular to them between adjacent metal surfaces 2 on one surface side of ceramic layer 1 congruently with the corresponding center lines on the other surface side of this ceramic layer.

Along this center line the ceramic layer on both surface sides is provided with predetermined breaking lines 3 (parallel to rows R1-R3) and with predetermined breaking lines 4 (perpendicular to rows R1-R3). Ceramic layer 1 is divided into a host of panels 1′ by predetermined breaking lines 3 and 4.

On the border of rectangular ceramic layer 1 in the embodiment shown the layer has on one surface side additional metal coatings in the form of strip-shaped metal surfaces 5 and 6, of which there are metal surfaces 6 each along one border area 1′′′ of ceramic layer 1 running parallel to predetermined

breaking lines 4 and there are metal surfaces 5 on border area 1'' which runs parallel to rows R1-R3 or the predetermined breaking lines. Between these additional, longitudinally stretched out metal coatings 5 and 6 and adjacent metal surfaces 2 or panels 1' there are predetermined breaking lines 3 and 4 on the two surface sides of ceramic layer 1. It goes without saying that these predetermined breaking lines 3 and 4 are provided on the two surface sides of ceramic layer 1 such that directly opposite one predetermined breaking line 3 or 4 on one surface side at a time is a corresponding predetermined breaking line 3 or 4 on the other surface side.

In the embodiment shown the additional metal surfaces are dimensioned and arranged such that predetermined breaking lines 3 between metal surfaces 2 and metal surfaces 5 extend as far as the border of ceramic layer 1 by the fact that metal surfaces 5 are each arranged with their narrower sides or ends on a common imaginary line with the long side of metal surfaces 6 which is outlying, i.e., facing away from metal surfaces 2, however metal surfaces 5 and 6 do not directly adjoin one another, but are spaced at a distance from one another.

Predetermined breaking lines 3 which run between metal surfaces 2 and additional metal surfaces 5 are cut by all predetermined breaking lines 4, and also by predetermined breaking lines 4 which run between metal surfaces 2 and additional metal surfaces 6.

With the exception of predetermined breaking lines 3 which run between metal surfaces 2 and additional metal surfaces 5

predetermined breaking lines 3 end on additional metal surfaces 6. In the same way all predetermined breaking lines 4 end on additional metal surfaces 5.

Basically it is possible to provide additional metal surfaces 5 and 6 on the two surface side of ceramic layer 1 or only on one surface side.

Metal surfaces 2, 5 and 6 are preferably surfaces of copper.

The described multiple substrate is produced for example by applying to the two surface sides of ceramic layer 1 a metal layer which completely or almost completely covers these surface sides in the form of a metal foil or thin metal plate which is joined flat to the respective surface side of ceramic layer 1 by means of a direct bonding process which is known to one skilled in the art from the literature and which is also called the DCB process when using foils or thin plates of copper.

Individual metal surfaces 2, 5 and 6 are then produced by subsequent prestructuring of the continuous metal layers on the two surface sides of ceramic layer 1. This structuring can be done using the most varied processes, for example by etching and/or mechanical processes. After structuring, i.e., after formation of metal surfaces 2, 5 and 6, using suitable techniques predetermined breaking points or predetermined breaking lines 3 and 4 are formed, for example, by laser treatment or mechanical processes.

In the described prestructured form the multiple substrate is delivered by the substrate manufacturer to the user who then processes this substrate as multiple panels in the production of

electrical circuits, especially power circuits, such that metal surfaces 2 are structured in the desired manner at least on one surface side of ceramic layer 1 using suitable techniques, for example, by masking and etching, in order to obtain the printed circuits, contact surfaces, etc. necessary for the circuit to be produced so that then a multiple panel with a host of individual substrates still joined to one another is obtained which can then, for example, be assembled by machine with the required components. Only after this assembly and if necessary after testing of circuits produced is the multiple panel separated into individual circuits by breaking ceramic layer 1 along predetermined breaking lines 3 and 4'. By means of additional metal surfaces 5 and 6 unwanted breaking of the multiple substrate or multiple panel in the process is effectively prevented. Because predetermined breaking lines 3 which run between metal surfaces 2 and additional metal surfaces 5 extend as far as the border of ceramic layer 1, the multiple panel can be separated into different individual substrates or circuits without the necessity of dividing one of the additional metal surfaces 5 and 6, i.e., when the multiple panel is separated into individual substrates or into individual circuits breaking takes place first on external predetermined breaking lines 3 adjacent to metal surfaces 5 and then on external predetermined breaking lines 4 adjacent to metal surfaces 6, with which then the border which has these additional metal surfaces 5 and 6 is removed and the remaining part of the multiple substrate can then be

separated without problems on predetermined breaking lines 3 and 4 by breaking.

Although predetermined breaking lines 3 extend as far as the border of ceramic layer 1 there is no danger that the multiple substrate will break in an unwanted manner during the process along these external predetermined breaking lines 3, since especially when the multiple substrate in the process is always seized during handling on two opposite side borders, no bending forces occur which could cause the substrate to break on outlying predetermined breaking lines 3. Basically, however, it is also possible to handle the multiple substrate in the process such that this substrate is always seized only on border areas 1''' which have metal surfaces 6.

Metal surfaces 5 and 6 can also be provided with structuring which forms coding, for example, with recesses 7 which form coding. This coding which can be read by automatic machinery can then contain information about the type of circuits to be produced and can thus be used to control and/or monitor the production process, but also to securely set a stipulated orientation of the multiple substrate in a processing device.

The invention was described above using one example of an embodiment. It goes without saying than numerous changes and modifications are possible without departing from the inventive idea underlying the invention. Thus, for example, it is possible to provide predetermined breaking lines 3 and 4 only on one surface side of ceramic layer 1. Furthermore, it is possible to

provide additional metal surfaces 5 and 6 on the two surface sides of ceramic layer 1.

Reference number list

1	Ceramic layer
1′	Panel
1″, 1‴	Border area
2	Metal surface
3, 4	Predetermined breaking line
5, 6	Additional metal surface
7	Recess
R1 - R3	Rows
S1-S4	Gap